NUTRIENT RELEASES TO THE MISSISSIPPI RIVER IN THE LOUISIANA INDUSTRIAL CORRIDOR

Voluntary Reductions in Nitrogenous and Phosphatic Compounds

EXECUTIVE SUMMARY

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Introduction

This report was prepared for the Louisiana Environmental Leadership Pollution Prevention Program to document industry's voluntary reductions in nutrient releases to the River within the Industrial Corridor. Current local and national interests in nutrient releases to the Mississippi River are related to a "dead zone" or "hypoxic zone" (low oxygen) on the Louisiana continental shelf in the Gulf of Mexico. This area of the Gulf, and associated estuaries are one of the most productive fisheries in the United States.

The data in this report are from the Toxics Release Inventory (TRI) Reports prepared by the Louisiana Department of Environmental Quality (LDEQ). Many of the reported reductions in releases are due to voluntary pollution prevention initiatives by industry, rather than compliance with regulations. The TRI reporting of ammonia and nitrate compound releases to surface water follow major reduction of pollutants in the 1970s under the Clean Water Act.

The Mississippi River Industrial Corridor (MRIC) is a highly industrialized area covering 12 parishes along the river. This region of the state contains about 48% of the Louisiana TRI reporting facilities, and accounted for approximately 77% of the state's total releases and 97% of releases to surface water in 1997. Releases in the MRIC continue to show an overall decline of approximately 75% from the baseline year (1987). Since this region has the greatest concentration of point source nutrient releases to the river, it is therefore the primary focus of this report.

In spite of major industrial growth between 1987 and 1998, industry through voluntary pollution prevention efforts has controlled the release of ammonia, nitrates and phosphoric acid to the river in the MRIC. Water quality data indicate that the nutrient levels in the river as it enters Louisiana are essentially the same when the water enters the Gulf of Mexico.

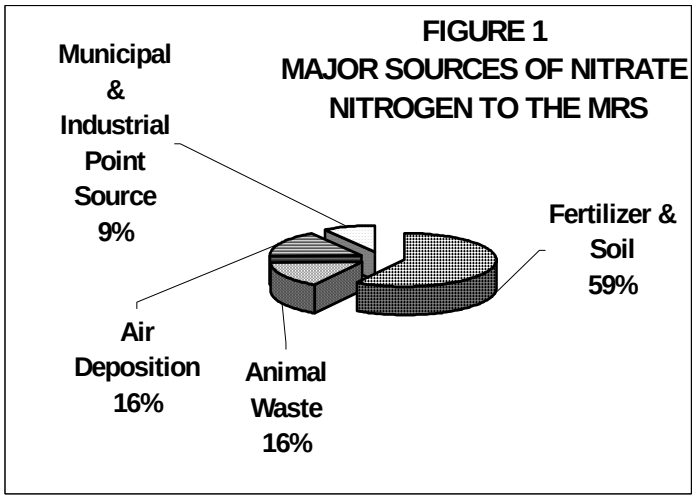
Mississippi River: The Mississippi River System (MRS), which includes the Atchafalaya River, is the largest drainage basin on the North American Continent. It collects the drainage from approximately 41% of the surface area of the 48 contiguous states. The basin stretches from Pennsylvania to Idaho and from Minnesota to Louisiana. The MRS provides 90% of the freshwater inflows to the Gulf of Mexico. The outflows of the Mississippi and Atchafalaya Rivers dominate the nutrient loads to the continental shelf where hypoxia is likely to develop. It

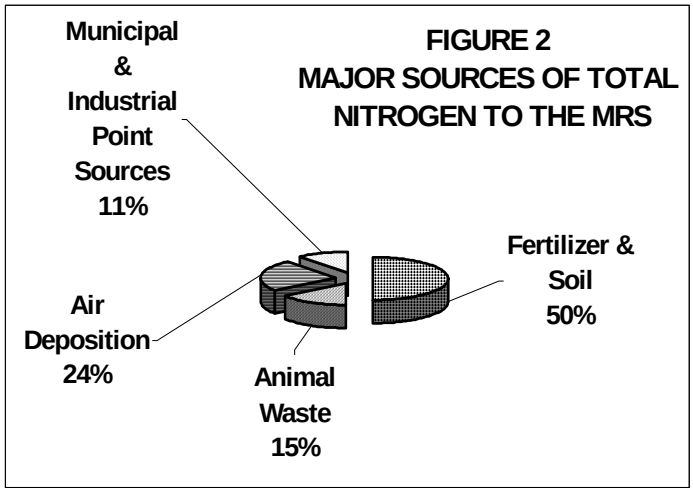
is estimated that about 70% of the Mississippi River system flows through the industrial corridor with the remainder flowing through the Atchafalaya River.

Hypoxia Zone: Reports of eutrophication and hypoxia in the near coastal waters in recent years has caused concern among scientists, commercial and sports fishermen, and the public. Increases in the spatial occurrence of summer hypoxic or dead zones along the Louisiana continental shelf have been attributed to increased loading of nutrients from the Mississippi River. Hypoxia and eutrophication are natural processes that occur in freshwater and salt water systems. Microorganisms in these waters and sediments respond to changes in nutrient concentrations, including carbon, nitrogen, phosphorous, and trace elements. Most studies of hypoxic areas have focused on phytoplankton productivity and its role in the eutrophication paradigm. The eutrophication paradigm is simply a sequence of processes, which occur as a result of external nutrient loading.

In response to reports of a growing hypoxia zone in the northern Gulf of Mexico, the "Mississippi River/Gulf of Mexico Watershed Nutrient Task Force" was formed in 1997. At the request of the task force, the White House's Committee on Environment and Natural Resources (CENR) was charged with assessing hypoxia in the Gulf. In 1998, a charge to submit an hypoxia management plan for the Gulf was written into law at the end of the 105th Congress (Section 604a of P.L. 105-383). The CENR Hypoxia Work Group was formed to conduct a scientific assessment of the hypoxia problem in the Gulf of Mexico. The work group teams prepared 6 interrelated reports which examined various aspects of the hypoxia issue.

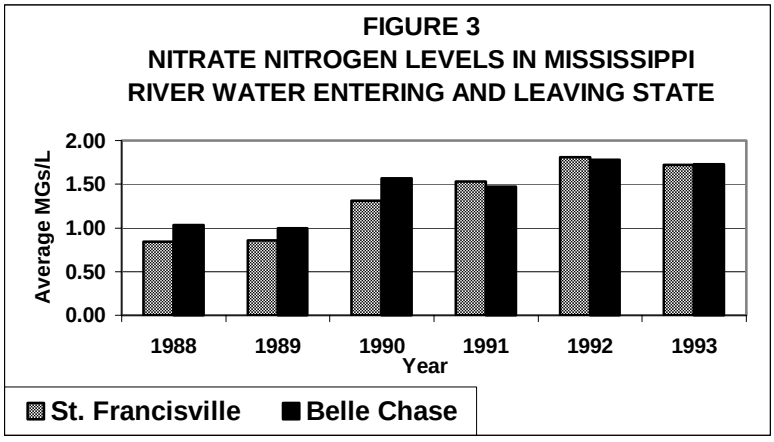
Nonpoint source nutrient loads from the upper watershed were identified by the CENR work group as the major source of nitrogen entering the MRS. Figures 1 and 2 present the estimates of nitrate nitrogen and total nitrogen sources in the MRS. It has been estimated that nitrate nitrogen represents 53% of the nitrogen exported to the Louisiana Shelf. Organic nitrogen accounts for 43% with ammonia and other compounds making up the remaining 4%.

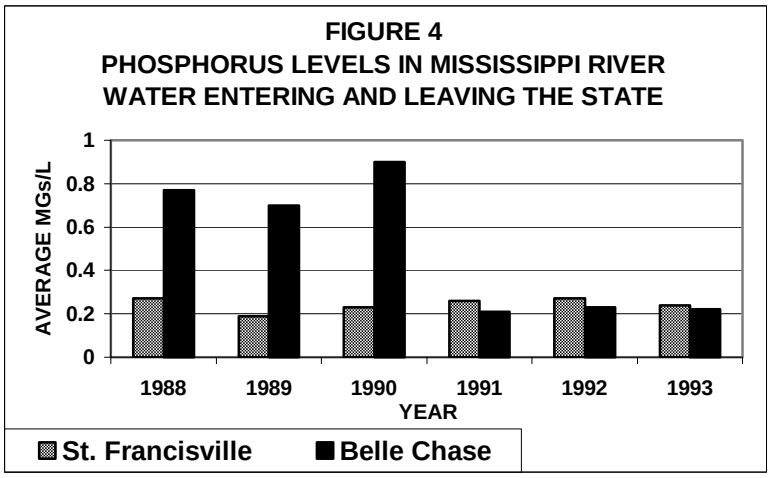




Figures 3 and 4 show the nitrate nitrogen and phosphorus levels in Mississippi River water entering the state at St. Francisville and leaving the state at Belle Chase. There is essentially no

significance difference in nitrate nitrogen levels in the river water entering and leaving the state during the sampling period. Phosphorus levels were high in the river water leaving the state in 1988, 1989 and 1990 but leveled off the following years. More extensive analyses of river water quality reported in 1997 support the conclusions that with the exception of a few phosphorus excursions, there is essentially no difference in river water quality entering and leaving the state.





Ammonia Releases from Industrial Point Sources within the MRIC

Ammonia and nitrate nitrogen reportedly are the key nutrients in the "hypoxia problem" in the Gulf of Mexico. Based on the data above, point sources represent only a small percentage of the nitrate nitrogen and total nitrogen discharged to the MRS. In Louisiana, point sources along the MRIC are important sources of nitrogen, as well as phosphorus releases to the basin. Table 1 summarizes the annual TRI ammonia and nitrate releases to the river from chemical plants, fertilizer plants and refineries within the MRIC from 1987 to 1998.

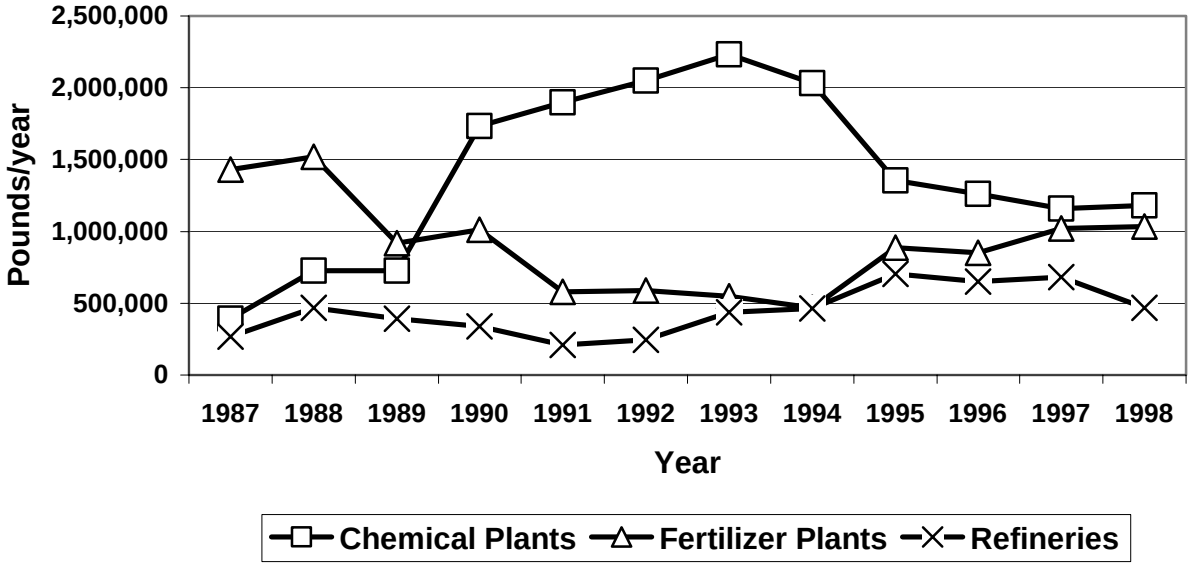
FIGURE 1
SUMMARY OF NITROGEN RELEASES FROM INDUSTRIAL POINT SOURCES IN THE MRIC TO THE MISSISSIPPI RIVER
(Pounds/Year)*

Source	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Chemical Plants - NH_4-N	390,150	724,157	725,327	1,734,427	1,897,522	2,048,522	2,231,057	2,034,221	1,354,073	1,258,950	1,157,149	1,179,507
Fertilizer Plants - NH_4-N	1,430,867	1,518,429	920,160	1,009,409	581,526	586,667	546,799	468,901	885,542	852,948	1,022,499	1,035,510
Refineries - NH_4-N	267,835	469,313	392,212	338,419	208,346	243,756	438,102	462,428	702,050	651,891	681,899	467,147
Total NH_4-N Releases	2,088,852	2,711,899	2,037,699	3,082,255	2,687,394	2,878,945	3,215,958	2,965,550	2,941,665	2,763,789	2,861,547	2,682,164
CF Ind. & PCS Nitrogen - NO_3-N	352,676	232,477	180,746	172,127	179,179	217,194	178,291	166,143	244,056	274,445	253,457	243,502
Total Process Nitrogen Releases**	2,441,528	2,944,376	2,218,445	3,254,382	2,866,573	3,096,139	3,394,249	3,131,693	3,185,721	3,038,234	3,115,004	2,925,666
Treatment Generated - NO_3-N***	-****	-	-	-	-	-	-	-	1,379,396	1,464,519	1,539,192	1,277,614
TOTALS	2,441,611	2,944,376	2,218,445	3,254,328	2,866,573	3,096,139	3,394,249	3,131,693	4,565,117	4,502,754	4,654,196	4,203,280

*Data obtained from DMR and TRI Reports. **Releases primarily from process wastes. ***Releases primarily from wastewater treatment and conversion of NH_4 to NO_3. ****(-) Indicates non reported.

Ammonia Releases: Figure 5 shows a general trend towards a reduction in the quantities of ammonia released to the river by the major industry sectors. Ammonia releases by the chemical sector increased between 1987 and 1993 and then declined. The large increase between 1990 and 1993 was due primarily to the release of ammonia by LaRoche Industries that represented 48% of the average total releases during that period. Only five of the 19 facilities reporting between 1987 and 1994 failed to reduce or increased the amount of ammonia released to the river.

FIGURE 5.
AMMONIA NITROGEN RELEASES FROM INDUSTRIAL POINT SOURCES TO THE MISSISSIPPI RIVER IN THE MRIC



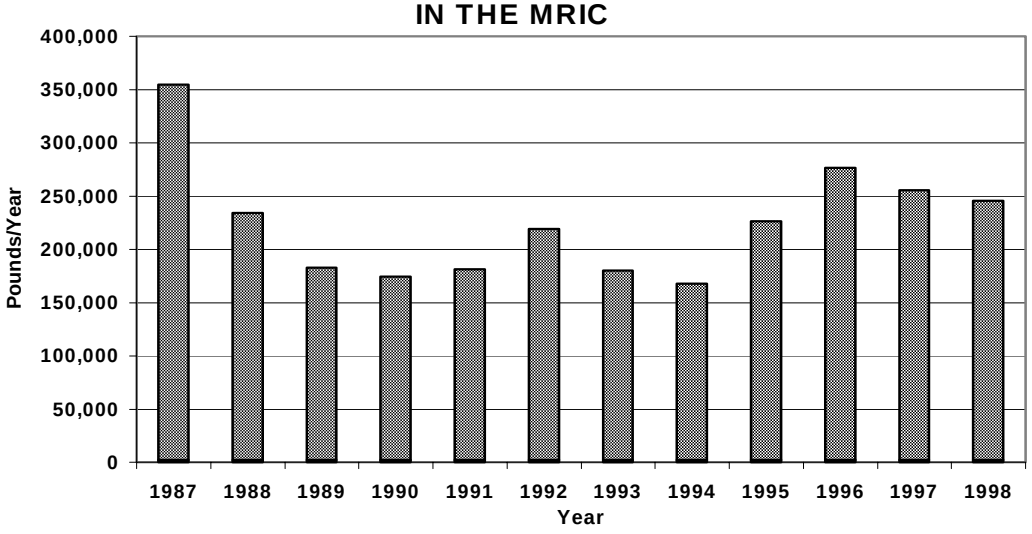
The refineries also were successful in controlling the amount of ammonia released to the river (Figure 5). This occurred during a period of increased throughput and processing changes between 1987 and 1998. Also, it should be noted that the chemical and refining industries made significant reductions in the quantities of pollutants released in the 1970's as a result of the Clean Water Act (CWA). Cytec and EXXON provide good examples to show the impact of the CWA on the discharge of ammonia.

A number of facilities participated in EPA programs to establish guidelines for industry sectors. For example, Cytec Industries reported ammonia nitrogen releases of 10,585,000 pounds to the river prior to the CWA in 1976. In 1977, the year the CWA and Best Available Control Technology (BACT) became effective, they reported releases of 3,139,000 pounds of ammonia nitrogen, and have continued to reduce releases. In 1998, Cytec reported 300,000 pounds of ammonia, for a total release of 233,281 pounds of ammonia nitrogen.

In 1973 only four refineries discharged to the river. The largest, EXXON Refining, discharged 1,861,500 pounds of ammonia nitrogen according to their original permit applications, which were based on actual discharge levels. This is the equivalent of 4lbs/year/barrel of daily refining capacity. In 1991, EXXON reported 32,000 pounds of ammonia or 24,883 pounds of ammonia nitrogen. This is equivalent to 0.07 lbs/year/barrel of daily refining capacity. Total annual ammonia releases to the river in the MRIC the last five years (1994-1998) averaged 5,279,270 pounds, or 4,105,183 pounds of ammonia nitrogen. In 1998, the TRI total nitrogen released to the Mississippi River in the MRIC was 4,203,280 pounds.

Nitrate Releases: Figure 6 shows that the two major nitric acid producers, CF Industries and PCS Nitrogen, controlled the release of nitrates in process wastes to the river during a period of increased production. Refineries and chemical plants that had installed biological and chemical treatment under the CWA to remove organics and ammonia were required to report nitrate releases for the first time in 1995 (Figure 7).

FIGURE 6.
NITRATE NITROGEN RELEASES TO THE MISSISSIPPI RIVER FROM CF INDUSTRIES AND PCS NITROGEN IN THE MRIC



Total Nitrogen Releases to the Mississippi River: Figure 7 summarizes total nitrogen releases to the river and shows the impact of reporting treatment generated nitrate-nitrogen in 1995. Figure 8 identifies the sources of nitrogen releases between 1995-1998 and indicates the significance of the treatment generated nitrate nitrogen. The 34% treatment generated nitrogen was used to adjust the total nitrogen releases prior to 1995 for nitrates generated by wastewater treatment systems. Figure 9 shows the adjusted total nitrogen releases to the river. Voluntary pollution prevention efforts by industry were responsible in part for the controlled release of both ammonia and nitrate nitrogen to the river in spite of major increases in production. Figure 10

presents the same adjusted total nitrogen data and the capital expenditures by industry in the MRIC during this period. This graphic shows that industry's voluntary efforts controlled releases during this period of rapid expansion and industry is committed to continue these efforts in the future.

FIGURE 7.
TOTAL NITROGEN RELEASES IN THE MRIC FROM INDUSTRIAL POINT SOURCES TO THE MISSISSIPPI RIVER

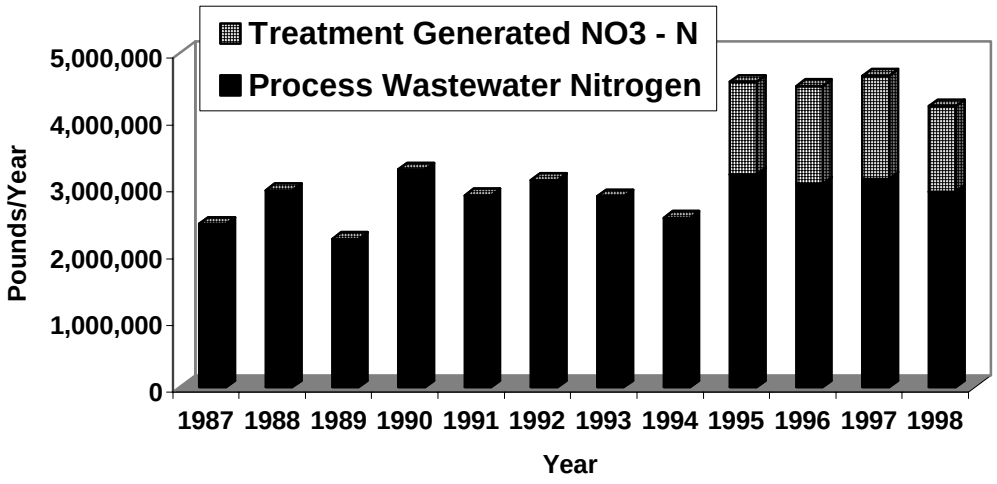


FIGURE 8.
SUMMARY OF AVERAGE NITROGEN RELEASES TO THE MISSISSIPPI RIVER FOR 1995-1998 IN THE MRIC

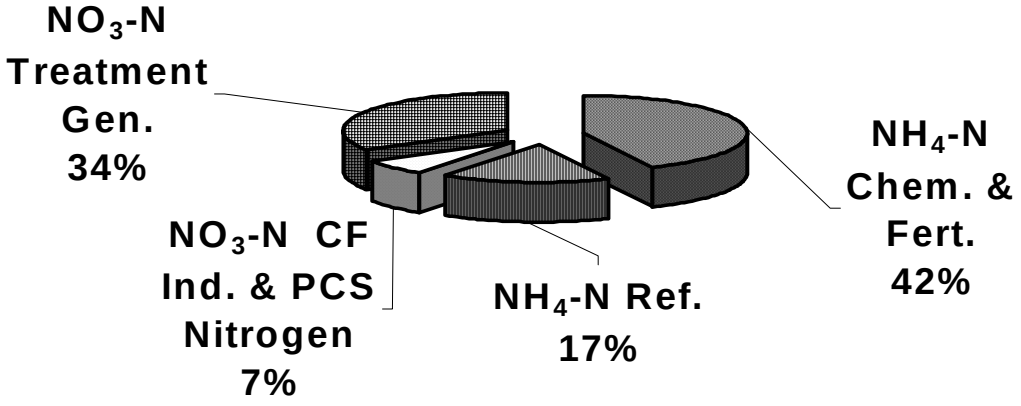


FIGURE 9.
TOTAL NITROGEN RELEASES TO MISSISSIPPI RIVER IN THE MRIC ADJUSTED FOR 34% WASTE TREATMENT NO_3-N

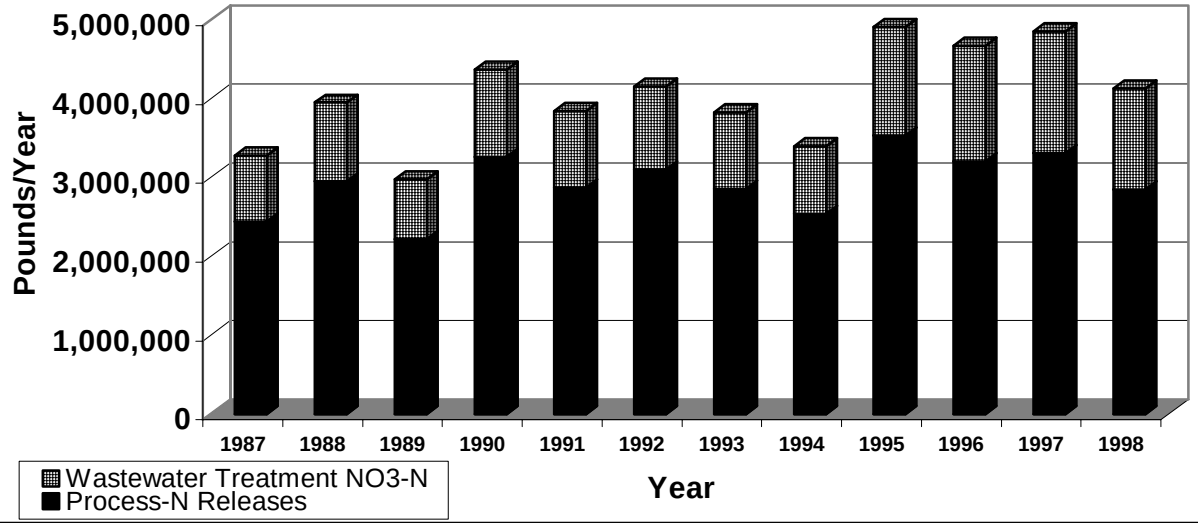
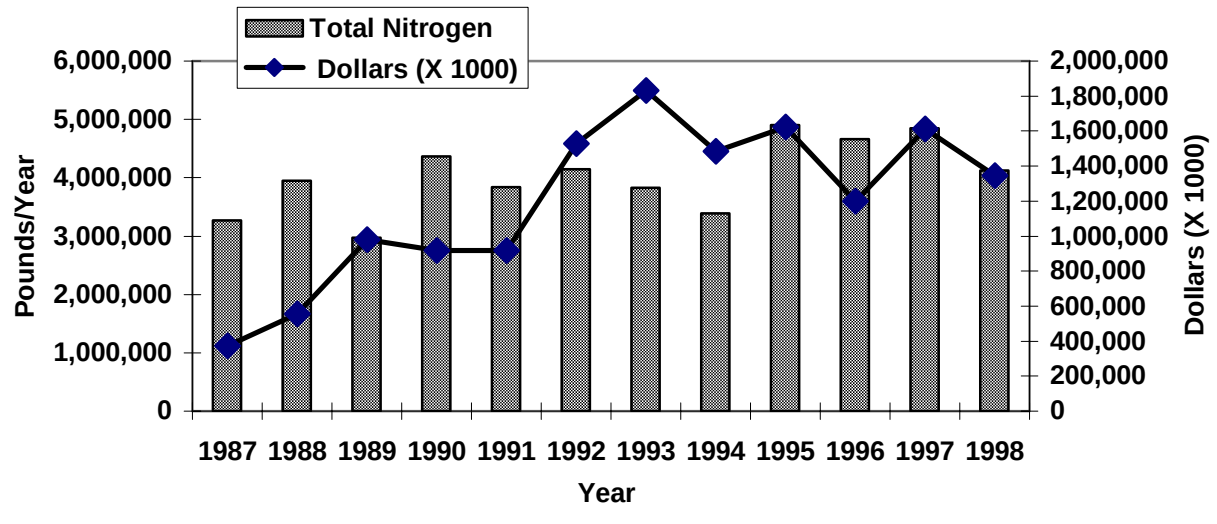


FIGURE 10.
COMPARISON OF CAPITAL EXPENDITURES AND TOTAL NITROGEN RELEASES TO THE MISSISSIPPI RIVER ADJUSTED FOR 34% TREATMENT GENERATED NO_3 - N PRIOR TO 1995 IN THE MRIC



For example, BASF reported significant nitrate compound releases between 1995–1998 that were generated in their ozone and biological treatment systems. They are currently modifying their biological treatment system to include bio-denitrification to convert nitrate to nitrogen. This voluntary pollution prevention effort will greatly reduce their release of nitrates to the river.

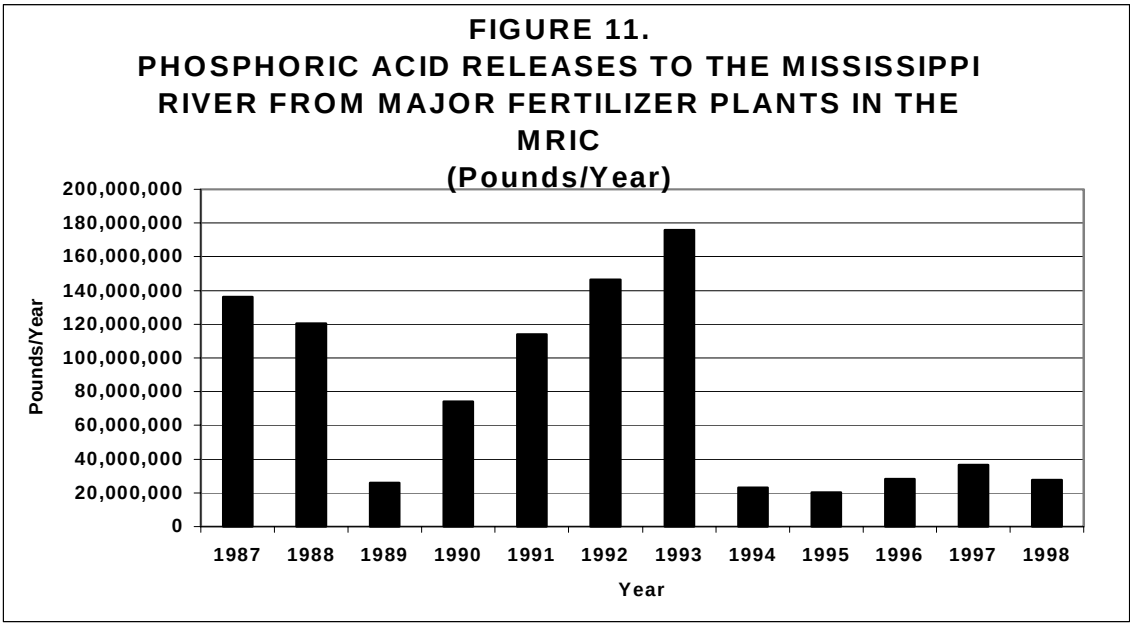
Ammonia Releases from POTW Point Sources: There are nine large Public Owned Treatment Works (POTWs) that discharge to the MRIC with a total dry weather flow of 229 million gallons per day. It is estimated that these plants discharge 12,116,540 pounds of ammonia to the river annually. This is over 3.5 times the 3,257,030 pounds of ammonia released by industry in 1998. The combined POTW and industrial point source releases of ammonia (15,373,570 pounds) are equivalent to 12,660,135 pounds of total nitrogen (82.35%). The total ammonia nitrogen releases from industry and POTWs represents only 3.26% of the estimated 388,080,000 pounds of total nitrogen discharged annually to the Gulf of Mexico from point sources in the MRS (CENR Hypoxia Work Group).

Phosphoric Acid Releases from Industrial Point Sources

The major nutrients released within the MRIC are phosphorus and nitrogen. While nitrogen compounds have received the most attention, phosphorus is an essential nutrient in the hypoxia paradigm but it does not seem to be limiting and thus receives limited attention.

The major sources of phosphoric acid releases to the river in the corridor are point sources from fertilizer plants. In 1998, there were four facilities discharging to the river: IMC-Agrico plants at Faustina, Taft, and Uncle Sam; and PCS Nitrogen, Ascension Parish. As a result of voluntary efforts, the fertilizer industry reduced phosphoric acid releases to the MRIC from a total of 120.8 million pounds in 1988, to a total of 28.4 million pounds in l998, a reduction of 76% (Figure 11).

FIGURE 11.
PHOSPHORIC ACID RELEASES TO THE MISSISSIPPI RIVER FROM MAJOR FERTILIZER PLANTS IN THE MRIC
(Pounds/Year)



Consistent with past pollution prevention efforts to voluntarily minimize releases to the environment, the Fertilizer Industry has recently agreed to have voluntary improvements incorporated into current and future water and solid waste permits should phosphoric acid be delisted from the TRI.

The fertilizer industry for a number of years has also recognized the need to implement programs to train dealers, extension service personnel, and users to optimize fertilizer utilization and minimize runoff. Their voluntary pollution prevention outreach efforts promote "Balanced Nutrition" as the key to optimization. In addition, they promote the environmental aspects of fertilizer use through soil sampling and testing to optimize fertilizer use, and improved tillage practices to control runoff.

It was estimated that POTWS in the MRIC release 6,513,060 pounds of phosphoric acid to the river. This is slightly more that 25% of what industry released in 1998.

Conclusions

In spite of major industrial growth between 1987 and 1998, industry through voluntary pollution prevention efforts has controlled the release of ammonia, nitrates and phosphoric acid to the river in the MRIC. Industry is committed to continuing these efforts in the future. Water quality data indicate that the nutrient levels in the river as it enters Louisiana are essentially the same when the water enters the Gulf of Mexico.